BOSTON UNIVERSITY

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Thesis

HIGH SCHOOL BIOLOGY AS A CONTRIBUTING FACTOR IN HEALTH EDUCATION.

Submitted by

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Biology - Study and teaching
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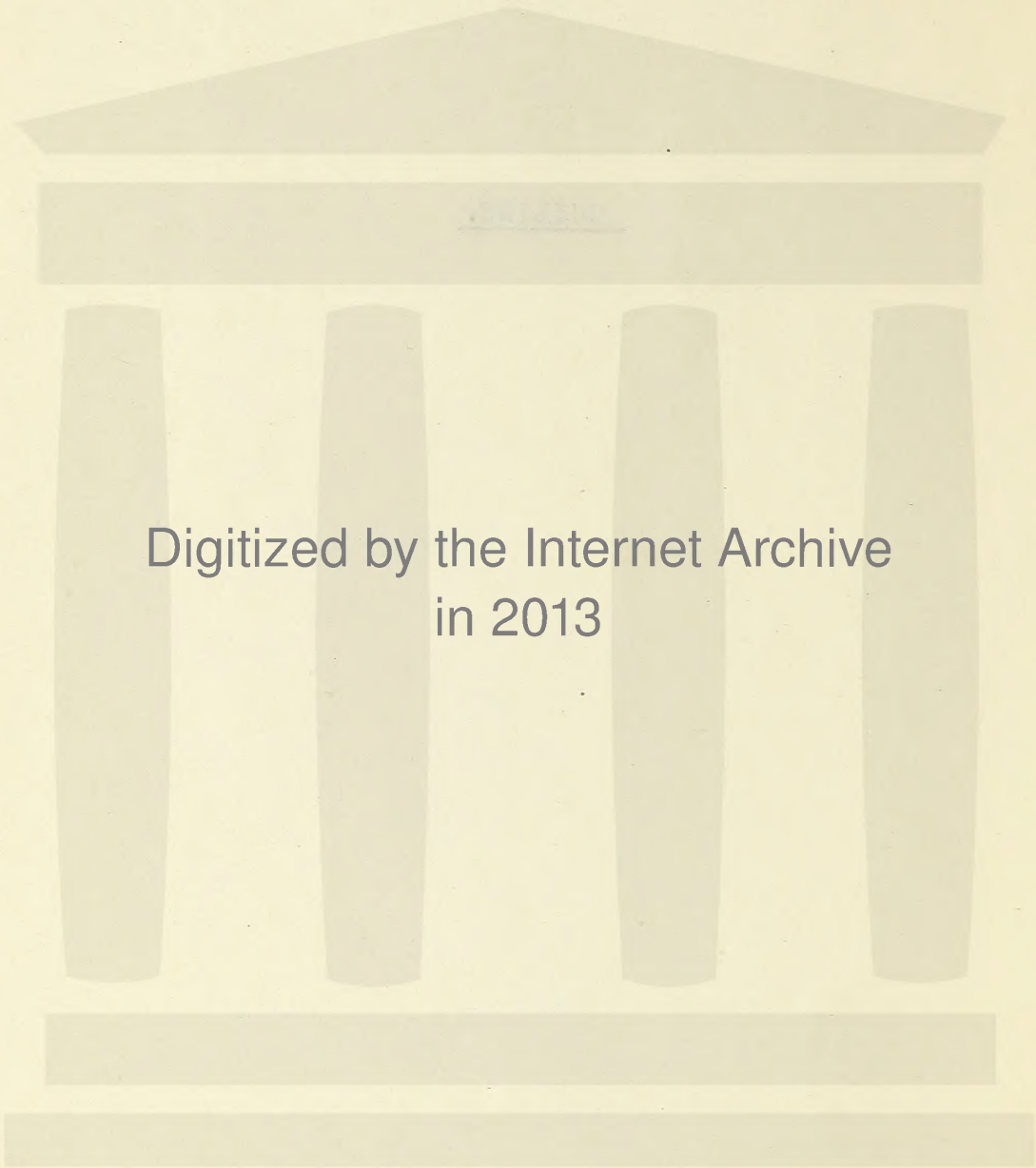
OUTLINE.



OUTLINE

HIGH SCHOOL BIOLOGY AS A CONTRIBUTING FACTOR IN HEALTH EDUCATION.

I. Aims of Biology Teaching.

A. Old aims and methods.

1. Emphasis on classification and morphology.
2. No attempt to show similarity in life principles.
3. Courses merely weakened type of college course.
4. Preserved specimens used almost entirely.
5. Microscopic work too difficult.

B. New requirements.

1. Methods.

a. Stress biological principles, functions and activities.
b. Emphasize similarity of living things.
c. Laboratory procedure based on interest and educational value.
(1). Dissection considered a waste of time when its only aim is to show evolution.
(2). Lecture-demonstration method is found to be better for fact getting than the laboratory method.
(3). Living organisms used.
d. Physiological and ecological materials used.

2. Aims

a. The teacher's aims.
(1). Cardinal principles of education.
(a). Health.
(b). Command of fundamental processes.
(c). Worthy home membership.
(d). Vocation.
(e). Citizenship.
(f). Worthy use of leisure time.
(g). Ethical character.
(2). Specific aims.
(a). Arouse, Foster and establish abiding interest in living things found in natural environment.
(b). Provide material which will stimulate worthwhile thought.
(c). Establish desirable mental attitudes.
1. openmindedness.
2. tentative theorization.
3. methods of scientific investigation.
a. questioning evidence.
b. logical procedure.
(d). Show relation of form and structure to function.
(e). Show the continuity of life.
Theory of evolution.
aim to develop individual point of view.
(f). Stress human welfare in relation to health.
1. lead to better under standing of needs of human beings through knowledge of requirements of plants and animals.
2. lead to cleaner personal and civic life through study of parasitic organisms.

3. spread valid scientific knowledge.
   a. results of scientific inquiry.
   b. application of scientific methods.
   c. work of boards of health, etc.
4. show man in his relation to other animals.
5. train in wholesome attitude toward sex.
6. lead the pupil to healthful diversion in pure air and sunshine.

b. The pupils' aims.
   (1). To understand the structure of their own bodies.
   (2). To find methods of preventing disease and loss of life.
   (3). To improve the health and beauty of the community.
   (4). To learn ways of securing better living conditions.
   (5). To learn how to distinguish harmful from beneficial plants and animals.
   (6). To find how to destroy harmful plants and animals.
   (7). To learn the proper way of utilizing living things for our benefit.
   (8). To find how to improve plants and animals.
   (9). To learn why and how we should conserve our natural resources.
   (10). To learn correct methods of farming and gardening.
   (11). To develop reasoning power.
   (12). To gain enlarged cultural outlook.

II. Health Education at the Present Time.
A. Aims of health education in the high school.
I. Physical health.
a. To give knowledge for scientific basis for health.
   (1). Cause of disease and its check.
      (a). What the community can do to promote health.
      (b). Common diseases.
   (2). Practical facts relating to cleanliness, sanitation food, fresh air, exercise, and rest.
   (3). What scientists have done for health.
      e.g. Pasteur, Koch, Reed, etc.
b. Apply the knowledge in healthful living standards.
   (1). Personal habits.
   (2). School habits.
   (3). Home habits.
   (4). Emergency habits.
c. Establish ideals and standards of health which will improve the life of the future.

2. Mental health.
a. Train in correct methods of study and concentration.
b. Inculcate the habit of success.
   (1). Self-confidence.
   (2). Agressive meeting of difficulties.
      (a). Exercise of will power.
      (b). Resourcefulness.
      (c). Persistence.
      (d). Decisive choice.
c. Develop a diversity of interests and attitudes.
   (1). Social.
      (a). Companionable attitude.
      (b). Sense of social responsibility.
   (2). Intellectual.
      hobbies, etc.

B.Present status of the movement.
I.Elementary schools.
a. Best methods evolved in elementary schools.
b. Emphasis is shifting from a control of passive environment to organization of active education in the interest of health as a result of the war.
c. Only that which shows the pupil why he must live hygienically in order to live happily and usefully is necessary.
(I).Practical health habits stressed.
(2).Anatomy and physiology study minimized.
(3).New texts more practical.
2.Secondary schools.
a. Health movement just reaching high schools.
b. Need for health teaching in high school is great.
(I).Supply scientific background for habits learned in elementary school.
(2).Mold public opinion of the future.
(a).Present pupils will be future parents.
(b).More intelligent treatment of health matters in the press.
(c).Better public understanding and co-operation in health matters.
C.Methods of teaching health in the high school.
I.Course should be broad enough to increase and develop physical wellbeing, a sound health knowledge, and wholesome health ideals, and should be narrow enough to make each fact taught function in the life of the pupil.
2.Basis for teaching.
a.Authoritative teaching in the elementary school. stress personal habits.
b.Social motivation in the intermediate school. stress community welfare.
c.Scientific basis in high school.
3.Health as a motive is ineffective.
a.Immediate reward necessary.
b.Psychology of habit formation.
c.In high school the need is to see that previously formed habits are not discarded.

III .Points of COrrelation Between Biology and Health Education.
A.Biology should not be expected to substitute for an individual course in health education.
I.Provide a firm foundation in understanding the principles of life.
a.Protoplasm.
(I).Content.
(2).Properties.
(3).Cell structure and physiology.
b.Fundamental processes.
(I).Nutrition.
(a).Food making and storing.
I. function of food.
2. carbohydrates, proteins, oils, minerals, vitamines,and roughage in various parts of plant

(b).Food taking.
I. relation of food to health.
a. deficiency diseases resulting from a lack of certain foods.
b. nutritive value of varicus classes of foods.
(I). keep a diet record to show proportions of each used.
(2). building of better food habits.
(3). correlation with weight and height.
c. development of self-control in the selection of food.
(c).Digestion.
(d).Absorption.
(e).Circulation.
blood and lymph.
(f).Assimilation.
(g).Constipation.
I. necessity for regular habits.
relation of food and drink to elimination.
2. care of skin, hair, etc.
(2).Respiration.
(a).Effect on general health.
(b).Obstructed passages.
(3(.Sensation.
(a).Nervous system of a frog.
(b).Physiology of habit formation.
build a health habit.
(c).Principles of mental health.
(4).Motion.
Exercise.
(5).Growth.
(a).Power of growth and repair.
(b).Keep H-W charts.
(c).Relate with nutrition.
(6).Reproduction and inheritance.
(a).Reproduction in plants gives excellent basis for wholesome attitude toward sex.
(b).Importance of heridity.
(c).Improvement of plants and animals by selection and breeding.

2.Show the interrelation of plants and animals.
a.Plants useful to man.
(I).Food.
(2).Clothing and shelter.
(3).Medicines and commercial products.
(4).Bacteria.
b.Saprophytes and parasites.
c.Insects and animals.
d.Insects and plants.
e.Carbon and nitrogen cycles.

3.Life histories of various organisms and their relation to man's health.
a.Protozoa.
Malaria, Yellow Fever.
Heroic struggles for control.
b.Bacteria, Yeasts, and Molds.

(I).Relation to man.
(a).Beneficial. -- stress these to avoid development of bacteriaphobia in class.
(b).Harmful.
I. cause food deterioration.
a. prevention methods.
b. relation to everyday life.
(I). homes.
(2). stores, etc.
2. cause disease.
a. avenues of entrance to body.
(I). abrasions in skin.
septicaemia, boils, tetanus.
(a). antiseptics.
(b). care of cuts.
(2). nose and mouth.
(a). tuberculosis.
cause
prevention
treatment
(b). pneumonia
(c). diphtheria
(d). typhoid fever
(e). bubonic plague
3. immunity and immunization.
a. natural.
b. acquired.
(I). vaccines.
(2). serums.
(3). antitoxins.
4. disinfection.
a. sunlight.
b. heat.
c. chemicals.
d. practical application.
(2).Experiments.
(a).(Place bacteria on sterile media in Petri dishes.)
I. effect of cold.
2. " " heat.
3. " " dryness.
4. " " sunlight.
5. " " disinfectants.
(b).(Expose sterile media in Petri dishes.)
I. dust room.
sweep "
brush "
vacuum "
2. let fly walk over the surface.
(c).Place material from dirty fingernails in sterile medium.
(d).Place scrapings from teeth in sterile medium.
(e).Have all experiments recorded with special attention to the practical application.
c.Poisonous plants.
(I).Fungi - some.
(2).Green plants.

poison ivy, poison sumach, poison dogwood, poison primrose, wild parsnip, etc.

(3).Individual idiosyncrasies.
tomatoes, strawberries, honey from some flowers, etc.

(4).Hayfever.
cause
treatment.

d.Insects.

(I).Flies.

(a).Menace to health.

(b).Habits and breeding places.

I. care of food.

2. care of garbage.

(c).Methods of destruction.

(d).Problem - Plan a campaign for ridding the community of flies.

(2).Mosquitoes.

(a).Relation to malaria and yellow fever.

(b).Special topics on campaigns against disease.

(c).Problem - Chart all possible breeding places in neighborhood.

(3).Body louse.
Typhus fever - uncleanliness. --frequent baths.

(4).Flea.

(a). Bubonic plague.

I. history.

2. control.

4.The contributions of scientific men to health.
Koch, Pasteur, Lister, Jenner, Trudeau, Reed, Carroll, Lazear, Howard, Laveran, etc.

5.The study of the human body.

a.Materials of the body.

b.Food and diet.
Organs of digestion.

c.Organs of circulation.

d.Organs of respiration.

e.Organs of excretion.

f.The nervous system.

(I).Parts.

(2).Functions

(3).Habit formation.

(4).Sense organs.

(a).Value.

(b).Causes of trouble.

(c).Care and protection.

6.What the community is doing to better the environment.

a.Government organizations.

(I).City.

(2).State.

(3).Federal.

b.Private organizations.

(I).American Child Health Association.

(2).Joint Committee in Health Problems in Education of the National Education Association and the American Medical Asso.

c.Colleges and institutions for investigation.
(I).Bussey Institute.
(2).Harvard and Johns Hopkins.
(3).Carnegie Institutes.
(4).Rockefeller Institute.
(5).Agricultural colleges of the West.

B.Indirect health teaching.
I.Much can be done for mental health.
a.Happy atmosphere in classroom.
(I).Cheerful co-operation.
(2).Concentrated effort.
b.Overcome unreasonable dislikes, fears, and superstitions.
(I).Bacteriaphobia.
(2).Handling of specimens.
c.Training to face things directly. Solve definite problems.
d.Form habits of neatness and cleanliness.
(I).Care of materials.
(2).Disposal of refuse.
e.Development of interest in outdoor life.
f.Wholesome attitude toward sex.
2.Posture.
3.Regulation of heat and ventilation of the room.

IV.Suggestions for Pupil Participation.
A.Oral themes.
I.Preparation of class.
2.Frequency.
3.Value.
4.Suggestive list.
B.Problems and investigations.
I.Excellent for review motivation.
2.Examples.
C.Field trips.
I.Management. Reports.
2.Value.
a.Direct -- facts gained.
b.Indirect -- interest and love of outdoors.
D.Exhibits.
Examples.
E.Debates.
I.Pupils interest in debating.
2.Value.
3.Suggested topics.

V.High School Provisions for Health Education.
A.Hygiene courses.
I.Recognition of need.
2.Four year courses.
e.g. Pennsylvania.
Gr. IX Industrial Hygiene.
" X Home "
" XI School "
" XII Health and the community.
3.Disadvantages of a one hour-one year course.
a.Lack of time.
(I).To cover subject matter.
(2).To inculcate useful habits.
B.Reorganized biology courses.
I.Change of focus to civic needs.

2.Characteristics of newer texts.
Hunter, Moon, Gruenberg, etc.

C.Organization of health work.
I.Well planned course for every grade of the high school.
Definite content and arrangement of material.
2.Definite correlative material assigned to the various subjects.
a.Major correlation with biology.
b.All subjects should contribute.
3.Active health committee of teachers in charge.
a.Co-operate with doctor, nurse, etc.
b.See that school environment is healthful.
c. Encourage healthful extra-curricular activities.
d.Keep the faculty in touch with the modern trend in health education.
e.Work out correlative programs best suited to the needs of the community.

VI. Summary.
A.Correlation of all subjects with health is necessary.
B.Biology is fundamental to a scientific knowledge of health.
C.Biology provides unlimited material for correlation.
D.Old methods should be discarded by all biology teachers. Adopt the new outlook.
E.The future shows promise of progressive work in this field.

THESIS.

HIGH SCHOOL BIOLOGY AS A CONTRIBUTING FACTOR IN HEALTH EDUCATION.

Although there has been a vast change in the aims and methods of teaching biology during recent years, many high school teachers are still devoting time and energy to attempting to pass on to their pupils a diluted type of college course. As a result, little that is educationally valuable can be derived from the course and biology falls into disrepute as a subject unsuited to the student of high school age.

It has been found that to stress classification and morphology instead of biological principles, functions, and activities is productive of no good results. The high school student is well able to grasp the great underlying factors such as the similarity of all living things, but he lacks background for the more detached study of morphology and classification. The stressing of this basic similarity has been almost entirely neglected until recently. Since its importance has been realized, attention is being directed toward the study of life histories and habits with increasingly good results.

Laboratory materials have changed as much as have method and technique. In former years, dried specimens of both plants and animals were used almost exclusively, while the student without an herbarium could not claim to have really studied biology. A great deal of time was

spent in the minute dissection of preserved specimens, and microscopic work far beyond the natural abilities of the pupils was prescribed. Progressive educators have radically changed this in recent years. Material for laboratory work is now selected on the basis of the interest of the pupil and its educational value. By such a viewpoint, the practice of dissection is absolutely abandoned when its only aim is to show evolution through morphology and its use is greatly minimized at all other times.

Wherever possible, living specimens are used and their and their fundamental processes studied. Although the individual laboratory method is valuable for giving the pupils first-hand, practical experience with organisms, it is not used exclusively at the present time because the lecture-demonstration method has proven itself far superior for fact getting. It is manifest that a single, well performed experiment by the teacher may produce more and better knowledge than when poorly done by each pupil.

The tendency to use physiological and ecological materials instead of purely morphological ones is growing. The pupils show the greatest interest in things from their own environment and thus civic biology is finding an important place in the biology course.

Underlying and motivating all of these changes in the method and content of the high school biology

course are the changes in aim which characterize all secondary education. These aims are crystallized as the Seven Cardinal Principles of Secondary Education which were compiled by the committee on the reorganization of secondary education, appointed by the National Education Association. The study of biology offers a unique field for the development of these aims. With the possible exception of the second, - the command of fundamental processes -, each one of the principles is closely bound up with the study of biology. For present purposes, the connection with health is to be most closely observed. It is safe to say that without health all of the other ends of education are either wholly or in part prevented from functioning properly. It is very necessary during the years of adolescence to give the pupil a firm scientific background for the habits and health knowledge which he has gained in the elementary school. The biology course provides unlimited material and opportunity for making health education its chief aim, both general and particular. In fact, it may be said that the justification of high school biology is, in large measure, its great contribution to the health knowledge of the pupil. Although training in the command of fundamental processes is not directly the work of the biology teacher, she must constantly be attentive to the demands for a high standard of English in her classes. To stretch the point a little,

one might class health habits among these fundamental processes. Under such classification, the biology course is a most valuable aid to the furtherance of the aim. Here close watch may be kept on the survival of previously formed habits and new or neglected ones may be inculcated. However, a direct contribution is made by biology to worthy home membership. Not only does it broaden the culture and interest of the student, but it also gives him a basis in scientific knowledge for forming a correct attitude in the family toward the care and control of communicable diseases, as well as personal and community hygiene and sanitation. The old, much adhered to superstitions concerning both health and disease are replaced by reasonable facts and practical knowledge. Although this training might have little or no effect upon this present generation of parents, it would be preparing an enlightened parenthood for the future. Moreover, it has numerous times been demonstrated that the ideals and customs which children acquire in school influence many parents to a great extent. This is especially true in the families of foreigners who look to their children for information about American ways of living. Biology teaching, particularly in its relation to health, gives the child a real apostolate in his home and in the community at large. In another phase of the study the pupil is interested in plant life and very often is lead to

cultivate a garden at home. He is shown the wonders which may be accomplished by allowing a bulb to sprout and he is given some idea of vegetable planting and cultivation. Hence, it is possible for him to start a "garden" anywhere from the spacious suburbs to the crowded tenaments. There are few things which add so much to the home atmosphere as does a growing plant. There is something about it which radiates the sense of security and peace which is the keynote of home.In all circumstances, the pupil has an opportunity to add to the beauty of the home surroundings and to the happiness of its members. Therefore, one of the chief aims of the biology teacher is to prepare the pupil for more worthy home membership.

In the great majority of cases, the vocation aim of biology teaching is indirect, but nevertheless, it is important. Regardless of calling, good health and the knowledge of how to retain it is indespensible for success. Biology gives valuable and direct training to those people whose life work is to be in farming or allied occupations. It teaches those who turn to the factories and shops of conditions which are necessary for safe living and warns them of the dangerous occupations. Those who enter higher institutions are prepared for more advanced scientific work and are provided with a basis in the knowledge of life functions.

Citizenship involves the social conduct of the in-

dividual and requires that he contribute his best to the interests of the community. Civic biology teaches the responsibility of the individual to the community and that of the community to the individual. It illustrates graphically the far reaching and disastrous effects of anti-social conduct as exemplified by carelessness in matters of disease. The pupil has a chance to see what the community is doing for his welfare and learns how best to co-operate with these efforts. The desirability of co-operation itself is clearly shown by the study of the interdependence of living things. Here the pupil may learn the ideal of true social conduct and by careful guidance be lead to contribute his best efforts toward it.

When high school biology is properly taught, it should foster a genuine love of nature and the outdoors, and should call the pupil to spend much of his leisure time in the fresh air. To a person who is ignorant of the wonders of the natural world, a walk in the country may seem hopelessly dull and boring. Give that same person a little insight into the life about him and the walk will take on a real significance. Frequent field trips and individual investigations and problems given with the high school biology course will show the pupil how to spend profitable and enjoyable leisure hours in the years to come. In some cases the study may develop into a hobby or avocation which will occupy leisure time in the

future. This may be in any form from the observation of wild life to the cultivation of a kitchen garden, but in all cases it will be a worthy use of leisure and serve as true recreation for the mind and body.

The biology course is very useful in pointing out to the pupil his duty to the community in that the harmful results of a lapse from that sense of responsibility are readily seen. Much can be done to foster ethical character during high school days because of the idealistic trend of the adolescent mind. The biology teacher should aim to develop a spirit of service to others in her pupils.

In addition to these general aims of all education, the biology teacher has certain specific aims peculiar to her individual work. Many of the pupils, especially in the city, come to her without even a rudimentary knowledge of nature and with no special interest in it. It is necessary, therefore, to arouse an interest in the immediate environment and so foster it that the pupil may carry the interest with him throughout life. Upon this basis of interest may be built the superstructure of detailed biological knowledge. The stimulation of worthwhile thought is very important in the mental development of the student. Therefore, the teacher must provide suitable material for such activity as well as material which will establish desirable

mental attitudes. The latter are of signal importance, since they should be the enduring effects of scientific study in the high school. The content of science is always changing, but the scientific attitude remains fixed. It is a great mistake to drill the pupil in specific knowledge to the exclusion of such qualities as open-mindedness, tentative theorization, and underlying methods of scientific investigation. The teacher should aim to impress the value of these qualities and show the pupil the need for willingness to hear all sides of a question before forming an opinion. It is essential,also, that he should be willing to change his ideas on a subject when new knowledge demands. Progress is always impeded by people who lack the ability to substitute new theories for old. In order to guard against too liberal or too changeable an attitude, the teacher must train the pupil to question the evidence carefully and build up an idea by logical procedure. This is a particularly good time for training in logical thought methods, since the mind of the pupil is in that phase of development.

Throughout the study of biology, the teacher aims to show the relation of form and structure to function and to let the pupil see the ways in which living matter adjusts itself to the exigencies of environment. At the same time he is given an idea of the continuity of life which leads to a consideration of the theory of

evolution. It is most necessary that the teacher give both pros and cons impartially and lead the student to think for himself in accepting or rejecting this important theory. In fact, the development of the individual point of view is of great value.

All of the foregoing specific aims are invaluable in providing a background for health work, but the biology teacher should aim at direct contribution to health knowledge. Wherever there is a diversity of material from which to choose, that which stresses human welfare in relation to health should be selected. Often a word will lead to a better understanding of the needs of human beings by relating the knowledge of the requirements of plants and animals with of man. During the study of parasitic organisms, the student should be lead to a cleaner personal and civic life through the stressing of sanitary habits and ideals. The relation of man to other organisms, both economically and biologically, is a point which cannot be disregarded. The biology course should acquaint the pupil with the results of scientific inquiry and their application to hygienic methods. This leads naturally to a study of the work of Health Boards and other similar organizations which have as their aims the spread of valid scientific knowledge. The biology teacher should strive at all times to present the subject matter in such a way that the pupils will develop a wholesome and natural attitude toward sex. One aid to this is the

study of life processes in plants and animals. Of equal value is the suggestion for healthful diversion in the fresh air to which nature study should lead.

It is important that the pupil himself should be conscious of very definite aims in his study of biology. Many of these aims may be formulated by the pupil at the beginning of the course and others may be suggested by the teacher. The class should make a list of the aims and keep it in a prominent part of the biology notebook where it may be referred to frequently. Mandl, in his biology review, gives twelve comprehensive reasons for the study of biology. These stress the health value very well, so they are given below.

The study of biology teaches us:

I. To understand the structures of our own bodies.

2. Methods of preventing disease and loss of life.

3. How to improve the health and beauty of the community.

4. Ways of securing better living conditions.

5. How to find how to distinguish harmful from beneficial plants and animals.

6. How to improve plants and animals.

7. How to destroy harmful plants and animals.

8. The proper way of utilizing living things for our benefit.

9. Proper methods of farming and gardening.

IO. Why and how we should preserve our natural resources such as:

Forests
Food and domesticated animals
Vanishing wild life

In addition, biology

II.Helps us to develop our reasoning power.

I2.Has cultural value. Life means more to a person who has a knowledge of biology.

With such a guide, the pupil is helped to see the real and vital meaning of the work in the course and is not lead along blindly through a maze of disjointed facts. He can see the practical value of biological knowledge in relation to his health as well as to his general education and interests.

For many years biology has been taught in the high school, but without particular reference to its relation to health education. In fact, health education is a new departure in itself, featuring as it does, correct habits of living rather than detailed knowledge of the possibly fruitless facts of anatomy and physiology. Fruitless, that is, in themselves, but most essential in part as a foundation for the health studies. However, only such knowledge of anatomy and physiology which has a direct health value should be given. Obviously, many time consuming exercises such as learning the name and position of every bone in the body should be omitted. In the place of such knowledge, that which will help to improve the physical and mental health of the pupil is stressed. First of all the health educator aims to give the high school pupil an understanding of the scientific basis

for health.It is important that he should know the facts about the more common diseases. This knowledge should include the infectious agent, the sourse, the site, the infectious discharge, the symptoms produced, and the effects of the disease upon the body as well as the method of control. In this relation,also, the pupil should be taught what he as an individual and the community at large can do in the checking of disease. By no means should this study of diseases be overemphasized, but it cannot be disregarded. Greatest stress should be given to facts relating to the preservation of health, such as cleanliness, sanitation, food, fresh air, exercise, and rest. The lives and contributions of the great scientists who have done so much for the promotion of health, as well as a study of current events in the battle for health should be of much value. The pupils should know what the leading investigators are now seeking and should be taught to have an intelligent interest in the news of their activities.

All of this knowledge is of doubtful value unless it is applied in healthful living standards. Many different sets of habits must be set up - each important in its own sphere. There are personal habits to be formed and maintained to preserve or improve the health of the individual. Another set of essential habits relating to school life must be observed, while still a third set

are necessary for correct living in the home. In addition, suitable habits must be formed to aid the pupil in rising to the various emergencies with which he may meet at one time or another.

These practical habits and definite knowledge must be accompanied by the formation of ideals and high standards of health which will not only inspire the pupils to improve their own health, but also will improve the life of future generations. The best possible time for developing and inculcating such ideals is in the high school period when the pupils are beginning to form their attitude toward life in general and are much more easily influenced by a high ideal than at other times.

Although the physical health of the school boy or girl is of utmost importance, there must be a conscious and purposive effort made to improve and strengthen the mental health for it has much to do with the proper functioning of the individual, however perfect he may be physically. In the health education course, the work for mental health is both subjective and objective. The pupil should be taught to employ correct and economical methods of study and should be aided in every way to develop his powers of concentration to the utmost. He should be given every opportunity to acquire the feeling and habit of success through his own efforts. He should be lead to know himself and to have confidence in his own power, so that he may act with independence and self-reliance. It is

important,also, that the pupil be trained to meet the situations of life squarely and aggressively. For this many qualities are necessary. First of all is the need for a strong will power. This may be acquired by conscious exercise and the health course offers many opportunities for such exercise. For example, restraint in the choice of foods, going to bed early, and countless others. To meet a situation well, the pupil needs resourcefulness which may be stimulated and trained by the solution of health problems bearing on everyday life. It is also most necessary that he be persistent in remaining steadfast until he has done away with the situation. This quality is often weak in high school students and all possible encouragement must be given for its development. Another problem of this age is the tendency to postpone making a decisive choice between things or events. For the mental health of the pupil, it is necessary that he be trained to overcome this weakness by much opportunity for the exercise of choice.

It is the part of education for mental health to develop a diversity of attitudes and interests, both social and intellectual, which will broaden the life of the pupil. He must be lead to have a companionable attitude toward his fellow pupils and to feel a real sense of responsibility toward the community at large. For the establishment of these attitudes, he must be helped to acquire the qualities of unselfishness, truth, honesty

and helpfulness. Intellectually, his interests must be broadened to give material for developing worthwhile avocations which will stimulate strong mental activity.

Although the movement for the health education of the individual is manifestly of the greatest importance, it has as yet hardly reached the high school. Beginning in the kindergarten, it has made its way upward through the grades meeting with great success. Since very little of the old type physiology has been taught in the lower grades, a clear field was provided for the evolution of the best methods with the advent of the new development. The experimentation in methods has been very progressive. As a result, it has been found that a control of passive environment is of much less importance than was previously supposed. The well known statistics of physical examinations during the war proved this beyond a doubt. Therefore, the importance of active education for health is being advocated more and more in recent years. In fact, the tendency to swing too far in that direction to the neglect of the passive environment must be carefully guarded against because neither phase is wholly satisfactory without the co-operation of the other. As for the direct teaching, only that which shows the pupil why he must live hygienically in order to live happily and usefully is necessary. To this end, practical health habits are emphasized and physiology study minimized. In answer to the new demands, the more recent

texts are omitting unnecessary details and are making their contents better suited to the interests and needs of young pupils.

Because of the long time which the health education movement has taken in reaching the secondary schools, pupils already trained in elementary health education are entering the high schools. This greatly facilitates the advance of the movement and allows for satisfying needs peculiar to the high school pupil. Hitherto, the student has been trained in habit formation with the minimum of scientific knowledge of reasons for the formation of the habits. The biology course is most useful in providing a satisfactory scientific background by means of which the habits may be supported. What is more, the proper training in health education is of the greatest importance in molding the public opinion of the people on such matters. Pupils who know the need for sanitary living conditions and hygienic habits will make the more efficient parents of the next generation. Not only will their own health be benefited, but also their children will be better trained in healthful conduct from infancy. Of equally high importance is the effect which a more intelligent understanding of health matters will have upon the press. It is a well known fact that newspaper reports on health subjects are frequently most inaccurate, often misleading to the point of harmfulness. Another important need for health education in the secondary schools is to establish a better understanding

and co-operation in health conditions between the public at large and the various health departments of the city and state. Ignorance has often lead not only to a lack of co-operation, but even to an antagonistic attitude and efforts to thwart measures for the check of disease. The high school can do much to ameliorate this condition.

It is plain, therefore, that, although the general methods of the elementary school are efficacious in the high school, the basis for teaching changes to meet the demands of older pupils and different subject matter. In the lower grades the teaching is authoritative, stressing personal health habits. When the pupil reaches the intermediate school, social motivation is used and importance is given to the study of the community as a whole. The high school should disregard neither of these factors, but the major foundation must be scientific knowledge which will explain the other two. Health,as a motive in itself, has been proven to be useless in the grades and it is no more effective in the high school. An immediate reward is necessary to insure strong motivation and the rather illusive reward of health is in no way sufficient. It necessary that all teaching be based carefully on psychological procedure. the course should be broad enough to increase and develop physical well-being, provide a sound health knowledge and wholesome health ideals, and it should be narrow enough to make each fact taught

function in the life of the pupil.

The high school biology course can be very closely allied to the work in health education, because a large part of the subject matter is identical. Nevertheless, it should not be expected to substitute entirely for an individual course in health education or to make a far-fetched correlation between the two subjects. To make the biology course function in health education no change of subject matter is necessary , but rather a change in perspective which is by no means difficult, since the new trend in biology emphasizes principles, functions and activities rather than classification and morphology. It is essential to a scientific education that the pupil be given a firm foundation in understanding the principles of life. To that end, the biology course teaches him the nature of protoplasm, its chemical, physical, and physiological properties, as well as important facts about the cell structure of living things. This leads to a study of the fundamental processes as found in both plants and animals with special relation to human conditions and health. Under nutrition, it is well to teach the importance of plants in providing food for animals. While studying food making and storing, the pupil may be taught the function of food and its composition. Carbohydrates, proteins, oils, minerals, vitamines and roughage should be given careful treatment both as to value and sources. This will lead to the process of food

taking where the relation of food to health is to be studied. Much valuable health work may be done under that topic. The various deficiency diseases and the nutritive value of different classes of food should be considered. While these studies are progressing, the pupils may start several health activities such as correlating height and weight with a diet record which should show the proportions of each food type used, or they might build better food habits. There is also the opportunity for the development of self-control in the selection of food.

When the pupils have studied food making and taking they are ready to follow through the processes of nutrition such as digestion, absorption, circulation and assimilation. Constipation should be given very special attention fron a hygienic viewpoint with emphasis upon the necessity for regular habits and the relation of food and water to elimination. At the same time the care of the skin and hair may be taken profitably and a campaign for good health habits in that direction may be launched.

In studying respiration, the effects upon general health are to be considered and enthusiasm for outdoor life should be fostered. The study of the nervous systems of various types, especially of the frog, offers opportunity for teaching the nature of sensation. The physiology of habit formation may be illustrated and learned through the building of a new or discarded health habit. At the

same time, the principles of mental health may be taught. Some of the class might keep graph records of an attempt to establish some quality such as self-control or persistence while the others are working on the health habit.

The study of motion may be correlated with the consideration of exercise and fatigue. The pupils might make a study of their own conditions, both in work and play. Although the power of growth and repair will have been met in the first study of protoplasm and later related to nutrition, it is important enough to require individual treatment. In correlation with this, a special study of Height-Weight charts should be made and efforts made to correct any defects which these may disclose.

In tracing the process of reproduction in plants and animals, there an excellent chance for producing a wholesome attitude toward sex. This may be done very simply through the use of plant material. Although human conditions are not identical with those of lower organisms, the principles of selection and breeding, as well as the effects of heredity and environment which may be developed at this point are helpful.

In addition to the correlation with health education of the fundamental life processes studied in the biology course, there are many points of correlation with the interrelations of plants and animals. From an economic viewpoint the use of plants by man may be considered. The study of those which give food, clothing, and shelter, medicines and commercial products all help to make more

clear the dependence of man upon the vegetable world. In this consideration bacteria cannot be overemphasized, but they may be studied more fully later on. The selection of saprophytes and parasites for study should be based on their relation to man's health and comfort. In making a choice, the needs of the section of the country rather than the general interest should be considered.

The relations of insects to plants and other animals also give a bisis for health studies. If the carbon and nitrogen cycles have not been covered by the work on nutrition, they may well be taken at this time.

Doubtless, the most important and practical correlation of biology and health education lies in the study of the life histories of various organisms in their relation to man's health. The malarial parasite not only serves as an excellent example of the life history of a parasitic protozoan, but also contributes valuable health information. The heroic struggles for the control of yellow fever in the Canal Zone by Reed, Carroll, and Lazear provide great inspiration.

In the study of bacteria, yeasts, and molds, many excellent and graphic experiments may be performed. In every case they should be recorded with special attention to the practical application of the conclusions reached. Some of the more important ones are listed below.

Effects of cold on bacteria.

Place bacteria on culture media in two Petri dishes. Place one dish on ice, the other in a warm place. Observe results in three days.

Effects of heat on bacteria.

Place bacteria on culture media on two Petri dishes. Allow one dish to remain in an ordinary temperature, Expose the other to a very high temperature for at least one hour. Place both dishes in a warm place for several days. Observe results.

Effects of dryness on bacteria.

Place a dry piece of meat on a dry blotter in a glass dish and a wet piece of meat on a water soaked blotter in a glass dish. Allow both dishes to remain in a warm place for a few days.

Effect of sunlight on bacteria.

Place bacteria on culture media in two Petri dishes Cover one dish with a light proof box. Expose the other to direct sunlight for a day, then place both in a warm place for several days.

Effect of disinfectants on bacteria.

Place bacteria on culture media in several Petri dishes. In all but one place various disinfectants. Let the dishes remain in a warm place for several days.

Bacteria in house dust.

Expose sterile culture media in a Petri dish while dusting a room.

Expose sterile culture media in a Petri dish while a room is being swept.

Expose sterile culture media in a Petri dish while a room is being brushed.

Expose sterile culture media in a Petri dish while vacuum cleaning a room.

Allow all of these dishes to remain in a warm place for several days, then compare results.

The house fly as a carrier of bacteria.

Prepare two Petri dishes containing sterile media. Allow afly to walk over one surface. Place both dishes in a warm place for several days. Observe results.

Bacteria carried under fingernails.

Place material from under fingernails in a sterile media in a Petri dish. Place the dish with a check in a warm place for several days.

Bacteria in the mouth.

Place scrapings from unbrushed teeth in sterile media in a Petri dish. Put this with a check dish in a warm place for several days.

Many similar experiments may be used to teach the characteristics of bacteria and from them numerous health conclusions may be drawn with desirable emphasis.

In studying the relation of bacteria to man, it is always well to pay special attention to the value of the beneficial bacteria in order to prevent the development of bacteria-phobia by some of the class. Then too. it is wise to stress methods of prevention and destruction of disease rather than the pathogenic activities of harmful bacteria. Only that which will help the pupil to better living should be included. Unnecessary details, especially those of an unpleasant nature must be eliminated for the good of the pupil.

When bacteria as a cause of food deterioration are considered, a project may be started by the pupils in applying the facts learned to the needs of their homes and stores. This leads,also, to the study of the methods of preserving foods and the relation of such methods to health.

As far as is possible, pathogenic bacteria should be considered from the preventive and destructive point of view as has been demonstrated. Although there are many different aspects from which the various diseases caused by bacteria may be considered, that of the avenues of entrance to the body is best for present purposes. Septicaemia, boils and tetanus which enter through abrasions in the skin lead to a consideration of first aid

and the subsequent care of cuts. Those which enter through the nose and mouth offer much profitable material for study. Tuberculosis shows splendidly the results of proper treatment in the care and prevention of disease. The importance of correct diet and living habits should be emphasized. The study of the Schick and Dick tests for determining susceptibility to diphtheria and scarlet fever is not only of intellectual interest and value, but also very important in removing old superstitions concerning those diseases and their treatment. In considering typhoid fever the pupil is lead to a general study of community sanitation which will be governed in its scope by the character of the environment.

A study of the principles of immunity and immunization is of signal importance and provides many interesting pieces of work such as topics for reports during the biological study of pathogenic bacteria. The experiments with disinfectants are sufficient to acquaint the pupils with exterior means of destroying bacteria.

Correlated with the study of green plants should be the study of poisonous plants. Previous to this certain fungi will have been studied; so poison ivy, poison dogwood, poison primrose, and wild parsnip will comprise the important part of the material. Not only should the pupils be taught the character of poisoning caused by each, but also the general characteristics of the plants and their habitats. At the same time such

details as the cause and treatment of hayfever may be studied, as well as certain personal idiosyncrasies such as tomato and strawberry poisoning.

Although the grasshopper is used as the type in the study of insects, the importance of smaller ones such as the fly cannot be disregarded. If the pupils have performed the experiments to determine whether the fly is a carrier of bacteria, they already have some idea of what a menace it is to health. If possible, it is well to have the fly pass through its life history in the laboratory. From this may be deduced methods of control and destruction, and also knowledge may be gained of habits and breeding places. A class problem might consist of planning a campaign for ridding the community of flies. The anopheles and stegomyia mosquitoes as disease carriers provide material for many special topics and class exercises. The class will find it interesting to chart all possible breeding places in the neighborhood and plan for their elimination. The flea, also, may be correlated with health work because of its relation to bubonic plague. The measures which the community takes for the control of that disease should be considered.

Throughout the biology course frequent study of the lives and work of distinguished biologists and others who have contributed to health should be made. Although the list is long, the more important ones are listed below.

Harvey ------- Discovered the circulation of the blood in the human body.

Lister ------- Father of antiseptic surgery.

Jenner ------- Originated vaccination for smallpox.

Metchnikoff --- Found the function of the white blood corpuscles.

Koch --------- Postulates. Discovered tuberculosis germ.

Pasteur ------ Founder of serums, vaccines, and antitoxins.

Howard ------- Proved that the housefly is a carrier of typhoid fever.

Laveran ------ Discovered the malarial parasite in the mosquito.

Reed, Carroll, and Lazear - Discovered the means of transmission of the yellow fever parasite.

Flexner ------ Worked on antitoxin for germ diseases.

Stiles ------- Discovered hookworm in the United States.

Trudeau ------ Started modern methods in the treatment of tuberculosis.

Civic biology is very interesting in itself and it is important in acquainting the pupil with the great agencies by which the community tries to protect itself from ill-health. Not only are the government organizations such as the city and state boards of health and the federal agencies to be considered, but also such private ones as the American Child Health Association, the National Tuberculosis Association, and the Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association. There are many colleges and research institutions to be considered, notably Bussey Institute, Smithsonian Institute, Carnegie Institute, Rockefeller Institute, Johns Hopkins, and many of the agricultural colleges of the West.

Thus far the correlations between biology and health have been in direct teaching. The indirect contribution is also of importance, especially in the province of mental health. The happy, purposeful atmosphere in the classroom should be such as to stimulate cheerful co-operation and concentrated effort. Many pupils come to the high school burdened with unreasonable dislikes, fears and superstitions concerning living things. In exchanging for these the scientific truth, the pupil gains greater mental stability and lessens the chances for unbalance in later life. The nature of the work demands that the pupil proceed logically, solving one problem after another as carefully as possible. This helps him to gain the habit of facing situations directly and solving them at once.

Although the carry-over may not be as effective as might be wished, habits of neatness in the arrangement of experiments, care of materials, and the disposal of refuse tend to impress the idea of order in other fields.

Since the biology course deals primarily with natural life, it develops an interest in the out-of-doors which might otherwise remain dormant. When the pupil knows something of the wild life which he meets, he is more apt to spend his leisure time in recreation such as hiking and other outdoor sports. In addition to these considerations, are those benefits common to all subjects which may be gained by attention to posture, heat, light, and ventilation during the ordinary class procedure.

As a summary for the entire course, the biological principles learned might be directly applied to the human body with special attention to the sense organs and any other details which have not been previously covered.

Because of the great amount of material which must be covered in a one year biology course, special pupil participation in the work is very effective. Probably the chief form which this will take is that of oral themes. To make this work really worthwhile, the teacher should demand that every topic reported upon should be prepared by every member of the class, but elaborated upon by the speaker. At the end of each presentation, there should be opportunity for a general class discussion. In this way every member of the class may be held respon-

sible for every topic. One or two of these topics might be taken at every lesson or one day a week might be devoted entirely to them.This type of lesson is very valuable, since it acquaints the pupil with sources of knowledge outside of his text book and also stimulates him to originate interesting methods of presentation. In addition to the purely biological subjects, there are many which afford excellent opportunity for correlating biology with health education. The following list suggests a few of them.

The Benefits of Sunshine to Man.
The Importance of Outdoor Exercise.
What Is Droplet Infection?
The Structure of the Teeth.
The Hookworm and Health.
What the Schick Test Does.
The Life Cycle of a Tape Worm.
Vitamines.
Swat the Fly!
How One Gets Malaria.
How the Canal Zone Was Cleaned.
The Value ofVegetable Oils.
The Advantage of Having a Garden.
Typhoid Fever.
Insects in the House.
Useful Bacteria.

How to Prevent Colds.

The Nitrogen Cycle.

The Carbon Cycle.

The Balanced Aquarium.

What Vaccination Means to Civilation.

Do You Recognize Poison Ivy?

How We Can Aid the Board of Health.

The assignment of problems and investigations offers an excellent means for motivating review. Some of these problems might be solved in a single lesson, whereas others might extend over a considerable period of time. A few general examples are:

Plan a campaign to free the community of flies.

Chart all possible breeding places for mosquitoes around your home.

Investigate sanitary conditions in a butcher shop.

When conducted properly field trips are of great value. It is most necessary, however, that each one be definitely worked out in advance and that the pupils know exactly the object of the trip. In all cases a written report should be submitted immediately after each expedition. The value of the trip to the pupil is both direct and indirect. Directly, he gains the facts which he went out to find. Indirectly , he gains an interest and love of outdoors which may help him then and later to a

more wholesome use of leisure time. However this depends largely on the proper motivation of the work.

The high school pupil has reached the stage where his mental development is almost entirely associative and logical powers are developing. Because of this he greatly enjoys argumentation. This phase should not be neglected in planning the work of the biology course. An occasional debate not only calls for earnest work on the part of the debaters, but also enlivens the class attitude. The following are representative of the type which may be used.

Resolved: That vaccination should be compulsory in the United States.

Resolved: That the city should provide more open-air playgrounds.

Resolved: That all milk sources should be examined frequently.

Resolved: That vegetation around a house is beneficial to health.

Although so much of the biology work can be made identical to that of health education, it is a serious mistake to depend upon such correlation for all of the health education. In fact, it is a great injustice both to the pupil and to the biology teacher to expect it. Most states now require some health teaching in all high schools, but the amount varies greatly. The general custom is to give a one year course which meets once a week. The disadvant-

ages of such a plan are obvious. In the first place, the time is too limited for the inculcation of health habits to any useful degree. Then too, only a minimum of subject matter can be covered in that time. There is also a chance for many sections to lose three or even four lessons in succession because of vacations and holidays. Although a one year course meeting three or four times a week would be far superior to the present one hour course, the more effective plan would be a four year course meeting once a week. Accompanying this course should be a carefully correlation with all subjects, particularly biology. In this way the pupils would be given time to develop new attitudes and would be helped to see that health education is not an unimportant "freshman subject", but a vital part of their daily lives. Pennsylvania has a four year course with a different objective for each year. In grade nine it is industrial hygiene, in grade ten it is home hygiene, while in eleven the school is the center of interest, and in grade twelve the subject of health and the community is considered.

The changing focus of biology teaching is being reflected in all of the better school texts which have appeared recently. The great majority of them are civic biologies, while others take such titles as Gruenbergs "Biology and Human Life", Most of the biology text books are divided into sections dealing with botany, zoology, and physiology separately, but the newer ones tend to

make correlations within the subject and are using practical material exclusively.

In order to obtain definite, worthwhile results in correlating any subjects, it is necessary that the course be carefully planned and the exact material which is to be correlated must be assigned to each department. This is especially true of health education. There is almost no high school course which cannot offer some points of contact, although the biology course is the one which gives the major correlation. Therefore, in the interests of efficient organization, some unitive force is necessary. The Cardinal Principles of Secondary Education suggest two solutions for the problem. One is to have a health director as a member of the principals council. "This council member should seek to ascertain whether the health needs of the pupil are adequately met. For this purpose he should consider the ventilation and sanitation of the building, the provisions for lunch, the posture of pupils, the amount of home work required, the provisions for physical training, and the effects of athletics. He should find out whether the pupils are having excessive social activities outside of school, and devise means for gaining the cooperation of the parents in the proper regulation of work and recreation. He may well see whether the teaching of biology is properly focused upon hygiene and sanitation." *

* Cardinal Principles of Education." Page 28

The other plan seems more practical and conducive of better results. It is to have a committee of teachers, possibly one from each department, in charge of the active work for health education. The duty of this committee would be to work out correlative programs for each subject basing its work upon the needs of the community and the character of the courses being considered. One of its chief functions would be to keep the faculty in touch with the modern trend in health education. Other duties would be to co-operate with the doctor and nurse, to see that the school environment is healthful and to encourage healthful extra-curricular activities.

The latter plan divides the responsibility and work in such a way as to involve more people of varied interests and abilities thus making for a more general interest than would the first plan.

SUMMARY.

While distinct courses in which health is taught directly should not be omitted from the curriculum, the value of indirect teaching through correlation with the other subjects cannot be overestimated. If pupils are to be taught the real importance and desirability of health, they must see the need for it in all phases of their lives. Each high school subject can contribute something toward the broadening of the pupil's health vision which a direct health education cannot do. Although the amount and worth of correlative matter varies with the subject, every possible chance for relating the work should be used. It is not necessary to talk health to the pupils until the word is a synonym for boredom, but through indirect methods a high health ideal may be inculcated.

The high school biology course teaches the underlying principles, functions, and activities of living matter, and is, therefore, fundamental to a scientific knowledge of health. In fact, next to the direct health education course, it contributes more and better material for correlation than any other course in the curriculum. This makes it the greatest contributing factor toward health education in the high school. However, in order to use this correlative force to its highest efficiency, biology teachers must discard the old methods which do not provide a perspective in health education. In their place

must be set up a new outlook which will motivate the establishment of health ideals, standards, and habits.

Health education in the high school is so new that in many localities the initial steps have not yet been taken. Nevertheless, the need is evident and all progressive educators are preparing to meet it. Without doubt, the future shows great promise of far reaching progress in that field. To that end, it is the duty of biology teachers to prepare themselves in methods of health education as well as in the botany-zoology section of their subject. When this is done, they will be prepared to lead in the campaign of health education.

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